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Big emitting nations and the 2°C target:beyond integrated assessment

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This year, the United Nations Conference of the Parties in Paris is tasked with delivering a land-mark agreement on avoiding the 2°C warming associated with 'dangerous interference with the climate system'. If this happens, it will re-invigorate analyses of how global and national energy systems can deliver the rates of mitigation accompanying the 2°C threshold. Commonly such studies rely on detailed integrated assessment models combining economic and physical relationships to describe climate and energy systems. These allow the user to develop 'feasible' scenarios in terms of technology, infrastructure and efficiency change. This paper reflects upon the reliance of decision makers on the outcomes of these models, and their suitability for producing plausible outcomes. One criticism is how they can explore future societies under the pressures of climate change mitigation and adaptation given that their economic parameterisations are underpinned by historical relationships fit for a world unperturbed by climate change. A second relates to their theoretical basis being appropriate for articulating the outcome of marginal change, when the very futures they are set up to explore involve non-marginal adjustments – very radical cuts in CO_2, or severe climate change impacts. Quantifying societal responses within such models is a particular challenge. Finally, these models downplay risks through disregarding low-probability, high-impact events and their consequences, including wars and migration. It is argued here that as currently formulated these tools are unsuitable for modelling the revolutionary transformations necessary to stay within 2°C carbon budgets, or similarly, futures with higher levels of warming and subsequent impacts.

To address this deficiency, this paper takes a complementary approach to contextually explore the 'possibility space' appropriate for avoiding 2°C. In contrast to exercises that build future scenarios using 'immutable' relationships within and between the energy and climate systems, a more transparent and dynamic framing based on highly constrained cumulative carbon budgets is proposed. Building on previous assessments that use a similar approach by authors Anderson and Bows, this analysis looks beyond the contested 'Annex 1' and 'non-Annex 1' division to backcast what the remaining CO_2 budget implies for the world's top emitting nations. The analysis takes the top 25 nations, responsible for 85% of global CO_2, and groups these nations on the basis of similarities within their energy systems. Using a range of explicit variables a suite of scenarios for these groups, as well as the 'rest of the world', 'deforestation' and 'bunker fuel CO_2' are then developed, all constrained within a range of 2°C carbon budgets. By varying the levels of near-term emissions from each group's energy system, under a highly constrained CO_2 budget, important sensitivities are revealed. Results demonstrate the significance of the coming 1-5 years' levels of emissions of the highest emitting groups and the importance of bunker-fuel emissions in shaping our collective futures. They also illustrate that only non-marginal futures with radical transitions across all energy systems can now be reconciled with the 2°C policy objective.